An online exploration of the biotic communities of Arizona
with an emphasis on Mathematics and Technology

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Exploring Biomes

Unit Overview

OVERVIEW

A biome is defined as a large geographic area containing similar plants and animals existing under the same climate conditions. There are eight biomes in the world: rainforest, savanna, desert, chaparral, grassland, temperate deciduous forest, temperate boreal forest, and tundra. Arizona has most of these biomes but because of the scale, many of them can be divided into smaller regions called biotic communities. In this unit, students will have the opportunity to explore both the biomes of the world and the biotic communities of Arizona.

The first lesson allows the students to use actual climate information (provided by satellite maps) to divide the world into biomes based on conditions that they choose. Then, in the second lesson, they are introduced to the actual biome classifications for comparison. After being assigned to groups, the students get the opportunity to become experts on one of these biomes. Lesson 3 exposes the students to a new controversy that has arisen in conservation biology. The students look at data regarding biome destruction and use it to analyze two different approaches to preserving the biodiversity of the Earth.

Arizona is introduced in the fourth lesson. The students use online resources to compare biomes to biotic communities. Looking at a map of Arizona, they estimate the amount of land that is taken up by each of the communities in the state. Finally, the students are back in groups and assigned a particular biotic community. Using PowerPoint, they must develop a short commercial to persuade people to visit this community.

Although these lessons were designed as a unit, they can stand by themselves and be taught individually. However, some activities may require familiarity with concepts or skills that were taught in earlier lessons. Make sure to read through the lesson and determine what knowledge your students are expected to know before carrying it out with the students.

SUGGESTED GRADE LEVELS

- 6 – 10

TIME FRAME

- 11 – 16 days (45 minutes each day)

ENDURING UNDERSTANDINGS

After completing the activities contained in this unit, the student should understand these basic concepts:

- A number of characteristics, including elevation and climate, are used to divide the world into biomes
- There are numerous ways to classify biomes, but many biomes, including rainforest, desert, and tundra, are commonly accepted

- At smaller scales, like states, biomes can be divided into smaller, more specific groups called biotic communities
- Because of its diverse range of elevations, Arizona has numerous biotic communities and is represented by almost all biomes
- Each biotic community in Arizona has unique plants, animals and climate
- Increasing human populations can negatively affect the diversity of plants and animals
- Conservation solutions are complex and not all people may agree

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

The lessons in this unit were designed to present an integrated approach to learning. Not only will the students be introduced to science concepts dealing specifically with ecosystems, but they will also use math and technology in meaningful ways. Through the course of this unit, they will calculate percents and ratios, estimate areas on a map, make pie graphs, use the Internet to perform research, and create a multimedia presentation. Although each lesson includes the specific performance objectives achieved for each grade level, the following general concepts are covered:

Subject	Strand	Lesson				
		1	2	3	4	5
Science	1	√	√	√	√	√
	2			√		
	3			√		
	4	√	√	√		√
	5					
	6	√	√			
Math	1	√		√	√	
	2		√	√	√	
	3					
	4	√			√	
	5					
Technology	1		√			√
	2		√			√
	3					√
	4					√
	5		√			√
	6					

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Exploring Biomes

Lesson 1: Mapping Biomes

LESSON OVERVIEW

In this lesson, students will look at satellite maps of the world, identify similarities among various regions, and attempt to divide the world into biomes based on these similarities.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- Climate is the primary characteristic used to divide the world into biomes.

OBJECTIVES

Students will:

- Interpret and compare maps containing different kinds of data.
- Classify world regions based on similarities in climate.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C3-01; S4-C3-01	S1-C3-01	None
7	S1-C3-01	S1-C3-01; S4-C4-08	
8	S1-C3-01; S1-C3-05	S1-C3-01	
High School	S1-C4-04; S6-C2-15	S1-C3-01	None

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- 1 day (45 minutes)

MATERIALS

- Picture of polar bear
- *Mapping Biomes* worksheet (one per student)
- Markers, crayons, or colored pencils
- Rulers
- Calculators

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TEACHER PREPARATION

- Make a copy of the *Mapping Biomes* worksheet for each student.
- Gather enough markers (or crayons or colored pencils), rulers, and calculators for students to use. They can share, if necessary.

SUGGESTED PROCEDURES

1. Show the students the picture of a polar bear. What animal is this? Explain that you have lived in Arizona for a long time and have never seen one in the wild. Why not? Lead this into a discussion about how most plants and animals can live only in certain areas of the world.
2. Introduce the concept of a *biome* by explaining that scientists have divided the world into a number of large geographic regions called biomes. They classify the biomes according to the kinds of plants and animals that can live there. The factor that usually determines which plants and animals can live in an area is climate, hence the idea that polar bears in the wild live in cold regions.
3. Hand out the *Mapping Biomes* worksheet. The students will now have the opportunity to become scientists and map the biomes of the Earth based on climate. Explain that the worksheet shows maps developed with data collected by NASA.
4. Point out that although the data are collected continuously throughout the year, students have been given maps of January 2002 and July 2002. Why were these months selected? They represent typical winter and summer months.
5. Students use the maps to divide the world into five to eight biomes. To do this they must look for areas that have similar temperatures and rainfall. These areas should probably be classified in the same biome, even if they are in different parts of the world. It should be noted that the students have been given maps for vegetation and primary productivity. Although these are not temperature or rainfall, they are indicators of climatic conditions. If you prefer, you could have students use only the maps for temperature and precipitation.
6. When students have determined how they will divide the world, they must color the biomes on the map provided and answer the questions.
7. Collect the worksheet when students have finished.

ASSESSMENT

- *Mapping Biomes* worksheet

EXTENSIONS

- Students can use reference materials to help them find one animal and one plant that live in each of the biomes, and identify adaptations that allow them to survive.

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
6	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
	4	3 – Populations or Organisms in an Ecosystem	1 – Explain that sunlight is the major source of energy for most ecosystems
7	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
8	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends 5 – Explain how evidence supports the validity and reliability of a conclusion
High School	1	4 – Communication	4 – Support conclusions with logical scientific arguments
	6	2 – Earth's Processes and Systems	15 – List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).

Mathematics Standards

Grade	Strand	Concept	Performance Objective
6	1	3 – Estimation	1 – Solve grade-level appropriate problems using estimation
7	1	3 – Estimation	1 – Solve grade-level appropriate problems using estimation
	4	4 – Measurement – Units of Measure – Geometric Objects	8 – Compare estimated to actual lengths based on scale drawings or maps
8	1	3 – Estimation	1 – Solve grade-level appropriate problems using estimation
High School	1	3 – Estimation	1 – Solve grade-level appropriate problems using estimation

Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

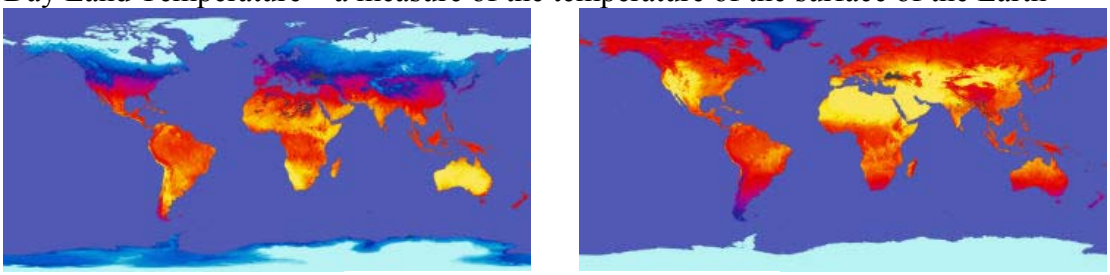
A. *Polar Bear Picture* – A photo used to get students thinking about adaptation to environments (1 page)

B. *Mapping Biomes* worksheet – A tool to help students learn how scientists divide the world into biomes (2 pages)

Mapping Biomes

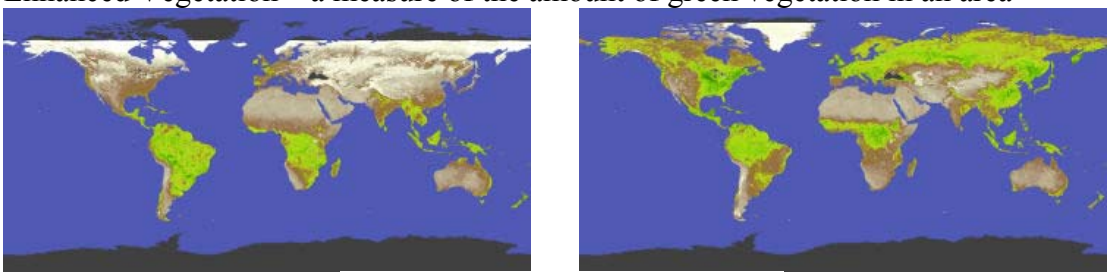
Use the NASA maps below to help you complete this worksheet.

Day Land Temperature – a measure of the temperature of the surface of the Earth



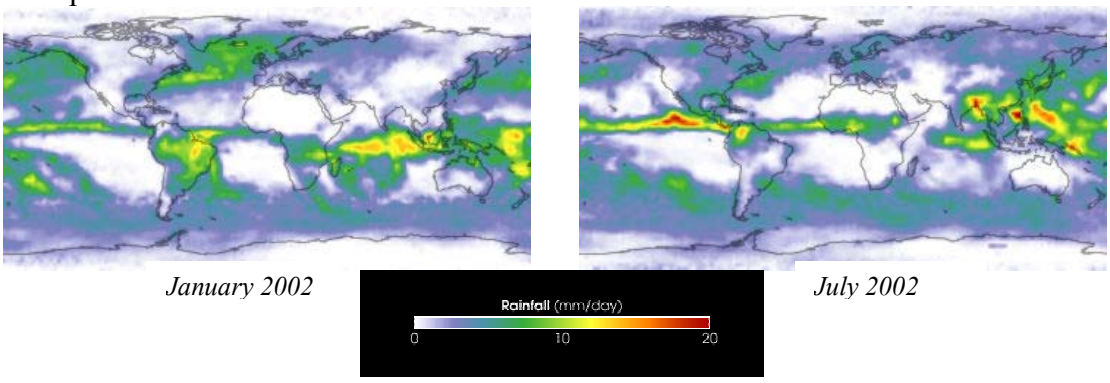
January 2002 *July 2002*

Enhanced Vegetation – a measure of the amount of green vegetation in an area



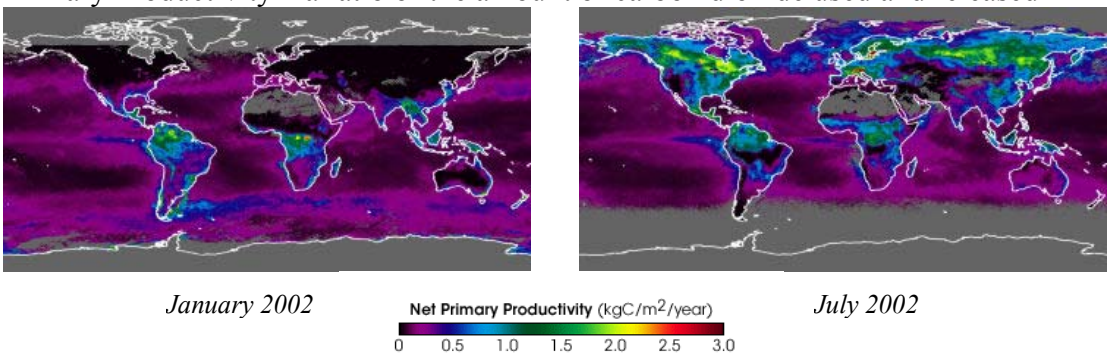
January 2002 *July 2002*

Precipitation – the estimated amount of rainfall



January 2002 *July 2002*

Primary Productivity – a ratio of the amount of carbon dioxide used and released



January 2002 *July 2002*

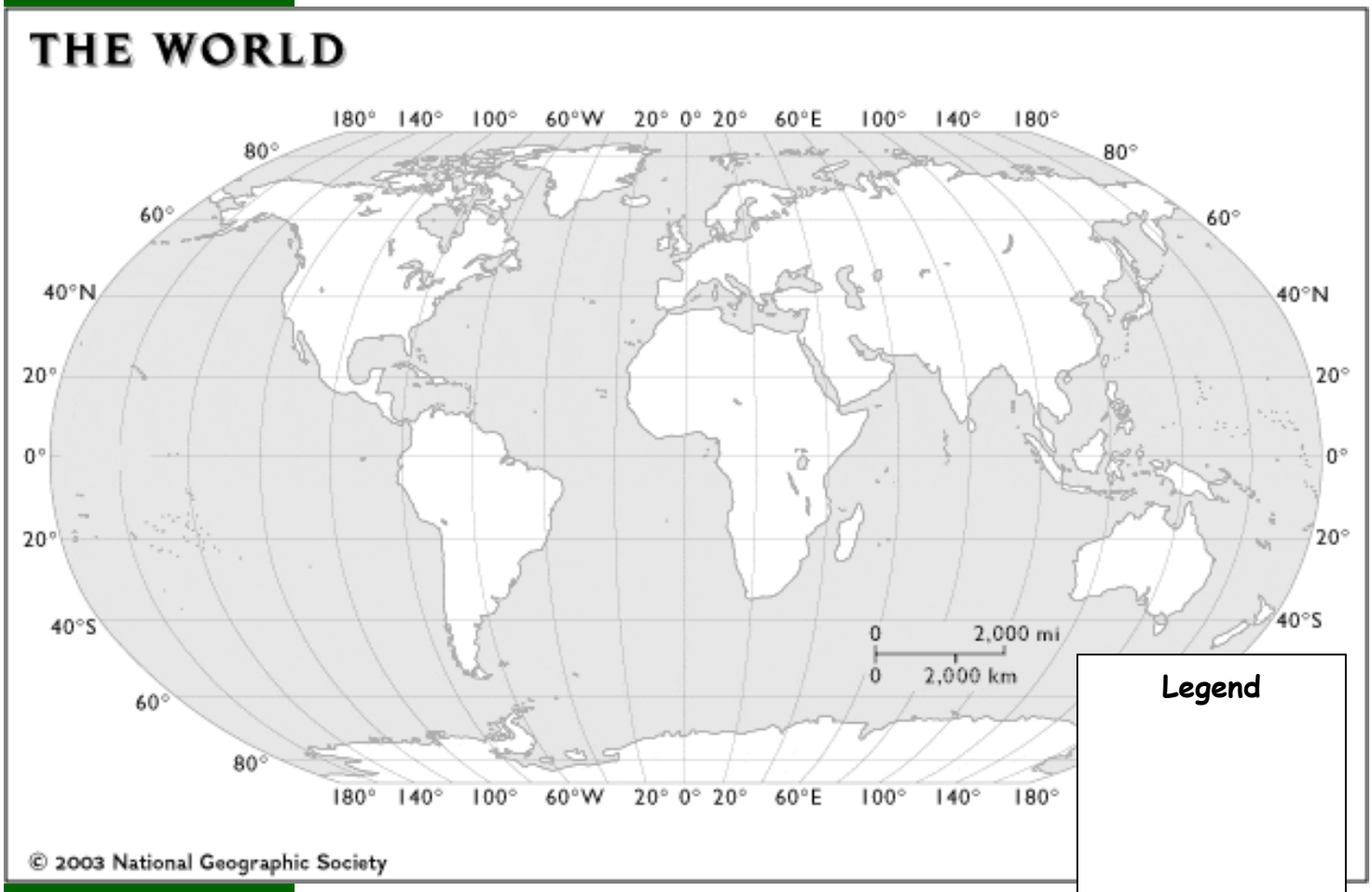
Exploring Biomes

Scientists define a biome as a large community of plants and animals. Biomes are primarily determined by similarities in climate.

The maps on the previous page are provided by http://earthobservatory.nasa.gov. They were developed using data collected by satellites and by Earth-based collection devices.

Use the maps to decide where the Earth's biomes are located. Look for areas with similar climate features. Divide the Earth into five to eight distinct biomes based on their similarities in climate. For the purposes of this activity, consider only land. Do not include the oceans!

Color the biomes on the map below, give the biomes a name, and make a legend.



Legend

Answer the following questions based on your map above.

1. Which biome is the largest? Approximately how many square miles is it?

2. Which biome is the smallest? Approximately how many square miles is it?

3. Explain briefly how you divided the biomes.

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Exploring Biomes

Lesson 2: Biome Research

LESSON OVERVIEW

In this lesson, a short PowerPoint presentation introduces students to the biomes that scientists have defined. Then, groups of students use online resources to obtain information about one of the world's biomes and present the information to the class. Finally, the students take a test that they have developed.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- A number of characteristics, including elevation, latitude, and climate, are used to divide the world into biomes.
- Scientists have defined numerous biome classifications, but certain biomes, including rainforest, desert, and tundra, are commonly accepted.

OBJECTIVES

Students will:

- Work in groups to achieve an assigned task.
- Use online resources to find relevant information.
- Present information gathered during research.
- Identify the similarities and differences among world biomes.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C3-03; S1-C3-04; S1-C4-01; S1-C4-03; S4-C3-01	S2-C1-02; S2-C1-03; S2-C1-07	1T-E2-02; 2T-E2-01; 2T-E2-02; 5T-E2-02; 5T-E2-03
7	S1-C4-01; S1-C4-03; S4-C3-01; S4-C3-06	S2-C1-03; S2-C1-04; S2-C1-08	
8	S1-C4-02; S1-C4-03; S4-C4-01	S2-C1-03; S2-C1-08	
High School	S1-C4-02; S1-C4-03; S4-C3-01; S4-C3-02; S4-C5-04; S6-C2-15	S2-C1-02; S2-C1-09	5T-P1-03; 5T-P1-04; 5T-P3-01

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- 3 – 5 days (45 minutes each day)

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MATERIALS

- Computer
- Multi-media projector
- Internet access
- *Biomes of the World* PowerPoint
- *Biome Research Guide* (one per group)
- Poster board, butcher paper, transparencies, or other presentation tools
- Markers
- *Oral Presentation Rubric* (one per group)

TEACHER PREPARATION

- Review the *Biomes of the World* PowerPoint and notes.
- Review the Web sites provided for grade level and content appropriateness.
- Divide the class into eight groups.
- Assign each group to one of the biomes mentioned in the PowerPoint.

SUGGESTED PROCEDURES

1. If Lesson 1 – Mapping Biomes was completed, discuss the results. How did you divide up the world? What difficulties did you have? How many biomes did you come up with? If Lesson 1 was not done, ask students to compare Arizona to Alaska. How are they similar? How are they different? Why are they different?
2. Introduce the purpose of today's lesson. Students will be looking at some biome classifications that many scientists use. Point out (as they may have discovered in Lesson 1) that there may be more than one way to divide the Earth, but there are some standard biomes that most people agree on.
3. Inform students that they will be viewing a short PowerPoint presentation. During the presentation, they should take some notes because they will be assigned to one of the biomes mentioned and will be require to research it in more detail.
4. Present the *Biomes of the World* PowerPoint. You may use the notes provided as discussion points.
5. Divide students into teams with approximately four members. Assign each team to research one of the biomes mentioned in the presentation.
6. Give a *Biome Research Guide* and *Oral Presentation Rubric* to each team and discuss the requirements. Inform teams that they will be using the Internet sites listed on the paper (if permitted, they can also search for additional sites). When they have enough information, they will develop a presentation to teach the class about their particular biome. In addition, they must write three questions about their biome that will be used for a test. They need to make sure that they provide the answers to the questions within their presentation.
7. Give the students a few days to put their biome presentations together.
8. Allow at least two days for presentations to take place.
9. Put together a test using the student-generated questions.

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ASSESSMENT

- Oral presentations using the rubric provided
- Student-generated test

EXTENSIONS

- Students can use their knowledge of biomes to analyze climate data from various cities and attempt to identify which biome it is in (see Appendix B)

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
6	1	3 – Analysis and Conclusions	3 – Evaluate observations and data reported by others 4 – Interpret simple tables and graphs produced by others
		4 – Communication	1 – Choose an appropriate graphic representation for collected data: • line graph • double bar graph • stem and leaf plot • histogram 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
	4	3 – Populations of Organisms in an Ecosystem	1 – Explain that sunlight is the major source of energy for most ecosystems
7	1	4 – Communication	1 – Choose an appropriate graphic representation for collected data: • line graph • double bar graph • stem and leaf plot • histogram 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
	4	3 – Population of Organisms in an Ecosystem	1 – Compare food chains in a specified ecosystem and their corresponding food web 6 – Create a model of the interactions of living organisms within an ecosystem
8	1	4 – Communication	2 – Choose an appropriate graphic representation for collected data: • line graph • double bar graph • stem and leaf plot • histogram 3 – Present analyses and conclusions in clear, concise formats
	4	4 – Diversity, Adaptation, and Behavior	1 – Explain how an organism's behavior allows it to survive in an environment

Science Standards Continued

Grade	Strand	Concept	Performance Objective
High School	1	4 – Communication	2 – Produce graphs that communicate data 3 – Communicate results clearly and logically
	4	3 – Interdependence of Organisms	1 – Identify the relationships among organisms within populations, communities, ecosystems, and biomes 2 – Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment
		5 – Matter, Energy, and Organization in Living Systems (Including Human Systems)	4 – Diagram the energy flow in an ecosystem through a food chain
	6	2 – Energy in the Earth System (Both Internal and External)	15 – List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography)

Mathematics Standards

Grade	Strand	Concept	Performance Objective
6	2	1 – Data Analysis (Statistics)	2 – Construct a histogram, line graph, scatter plot, or stem-and-leaf plot with appropriate labels and title from organized data 3 – Interpret simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs 7 – Compare trends in data related to the same investigation
7	2	1 – Data Analysis (Statistics)	3 – Determine when it is appropriate to use histograms, line graphs, double bar graphs, and stem-and-leaf plots 4 – Interpret data displays including histograms, stem-and-leaf plots, circle graphs, and double bar graphs 8 – Compare trends in data related to the same investigation
8	2	1 – Data Analysis (Statistics)	3 – Determine the appropriate type of graphical display for a given data set 8 – Compare trends in data related to the same investigation

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Mathematics Standards Continued

Grade	Strand	Concept	Performance Objective
High School	2	1 – Data Analysis (Statistics)	2 – Organize collected data into an appropriate graphical representation 9 – Draw inferences from charts, tables, graphs, plots, or data sets

Technology Standards

Grade	Strand	Concept	Performance Objective
6, 7, 8	1	2 – Demonstrate increasingly sophisticated operation of technology components	2 – Retrieve and save information remotely (e.g., network servers, Internet, Intranet, peripheral devices)
	2	2 – Exhibit legal and ethical behaviors when using technology and information and discuss consequences of misuse	1 – Follow rules for deciding when permission is needed for using the work of others, (e.g., some sites specify whether permission is required or not, some work is in public domain) 2 – Obtain permission to use the work of others
	5	2 – Evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources	2 – Gather research from a variety of electronic sources and identify the most appropriate information for answering the research question 3 – Obtain permission, when appropriate, to use the work of others
High School	5	1 – Develop a research strategy to find accurate, relevant, appropriate electronic information sources	3 – Independently select appropriate electronic resources from school, community and the world (via online) to be used to locate information needed when presented with a problem to solve 4 – Evaluate the appropriateness and effectiveness of electronic resources (e.g., purpose, credibility of author)
		3 – Present research findings from electronic resources using academic models for citations and formats	1 – Utilize evaluation criteria (authority, accuracy, relevancy, timeliness) for information found on the Internet to present research findings

Appendix B: Making Climographs

1. Explain to students that a climograph summarizes a location's climate in one simple graph. The graph contains both the average temperature and the rainfall for that location during each month of the year.
2. To be consistent, all climographs should follow the same format. The months should always be located on the bottom of the graph. Precipitation or rainfall should be on the left vertical axis and is represented with a bar graph. The average temperature should be on the right vertical axis and is represented with a line graph. Of course, there should always be a legend explaining the graph. See Graph 1 for a climograph for Flagstaff.
3. In the tables below, there is climate data for five United States cities. Have the students practice making climographs using this data. *Note: temperatures are listed in degrees Fahrenheit.*
4. When they are familiar with the climographs for various biomes, students should try to identify in which biome each of these cities can be found.

Graph 1 Climograph for Flagstaff, AZ

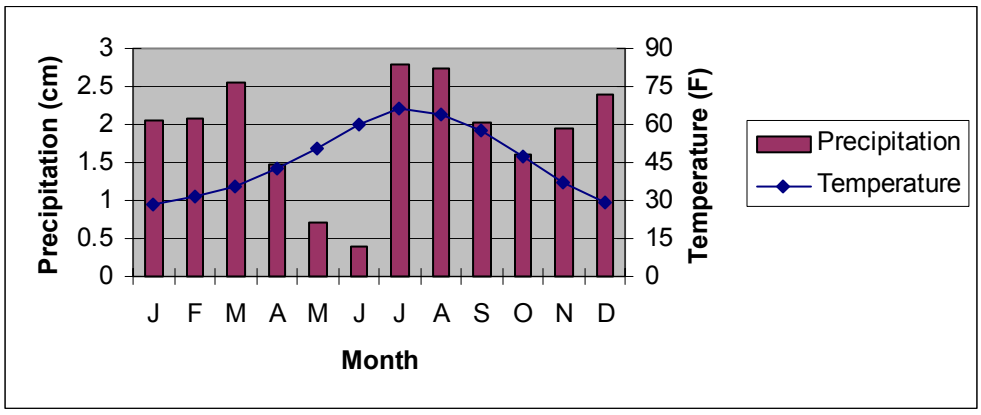


Table 1: Climate Data for Yuma, AZ

Temperature (F)	56.5	60.7	64.9	71.4	79.0	87.6	93.7	92.7	86.8	76.2	64.2	56.4
Precipitation (cm)	0.35	0.22	0.21	0.14	0.04	0.02	0.26	0.64	0.31	0.29	0.24	0.45

Table 2: Climate Data for Cold Bay, AK

Temperature (F)	28.6	27.4	29.9	33.3	39.6	45.7	50.5	51.5	47.7	39.6	34.4	31.0
Precipitation (cm)	2.84	2.27	2.16	1.97	2.29	2.10	2.52	3.24	4.41	4.34	4.19	3.67

Table 3: Climate Data for Lihue, HI

Temperature (F)	71.6	71.6	72.7	74.0	75.8	77.8	78.9	79.5	79.2	77.6	75.5	72.9
Precipitation (cm)	5.89	3.33	4.17	3.50	3.15	1.69	2.13	1.76	2.37	4.41	5.45	5.15

Table 4: Climate Data for Wichita, KS

Temperature (F)	29.5	34.8	45.4	56.4	65.6	75.7	81.4	79.3	70.3	58.6	44.7	33.0
Precipitation (cm)	0.79	0.96	2.43	2.38	3.81	4.31	3.13	3.02	3.49	2.22	1.59	1.20

Table 5: Climate Data for Olympia, WA

Temperature (F)	38.0	41.1	43.8	47.5	53.2	58.7	62.9	63.3	57.9	49.7	42.5	38.2
Precipitation (cm)	8.01	5.77	4.95	3.29	2.09	1.63	0.82	1.29	2.26	4.31	8.05	8.12

Data provided by http://www.mobot.org/education/02programsresources/mappingenvironment/mynaturalcommunity/front.htm

Appendix C: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

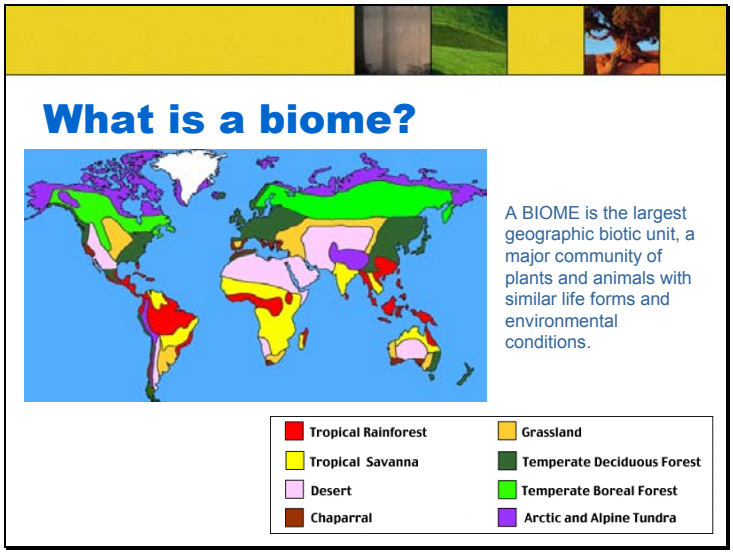
A. *Biomes of the World* PowerPoint – Use these notes to assist you in your presentation (14 pages)

B. *Biome Research Guide* – A worksheet that provides all of the requirements for the group research project (1 page)

C. *Oral Presentation Rubric* – One method for grading the group presentations (1 page)

Slide 1

Slide 2

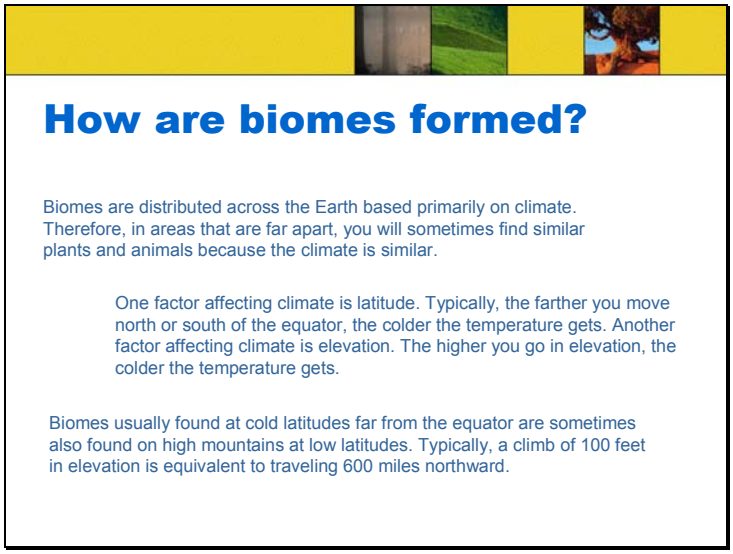


A biome is a large geographic area containing similar plants and animals. This map shows the locations of some of the major biomes of the world.

Each biome can have distinguishing characteristics based on local factors. For example, within the desert biome, there may be hot, cold, and coastal deserts, each with slightly different climates.

It is possible to divide the biomes into smaller units that we call biotic communities, ecosystems, or habitats.

Slide 3



Climate is a major factor in forming biomes because it is a major factor in controlling which living organisms survive.

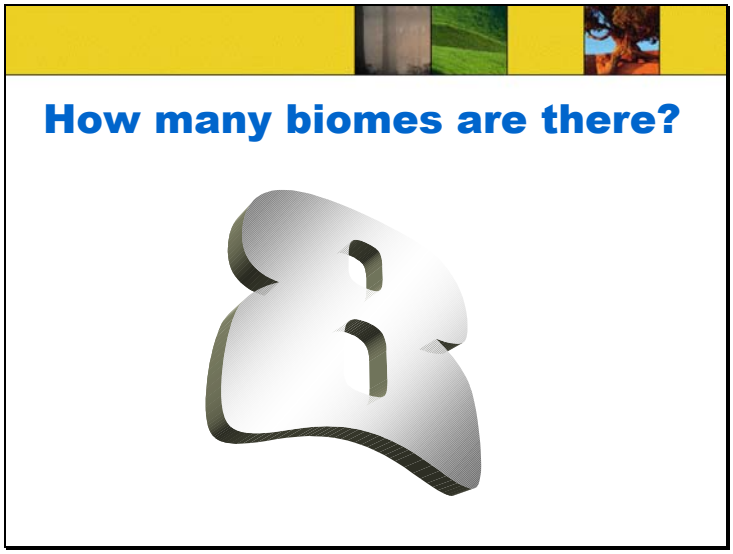
Most plants that live in cold climates have developed similar adaptations to the cold, and those adaptations are significantly different from the ones required to survive in warm climates.

As a result, areas with similar climates (on a global scale) have similar biotic communities and are therefore considered the same biome.

Climates change as we move north or south from the equator. As a rule, temperatures drop the farther you get from the equator. Therefore, many biomes are distributed along very distinct lines of latitude. For example, deserts are typically found around 30 degrees North or South latitude.

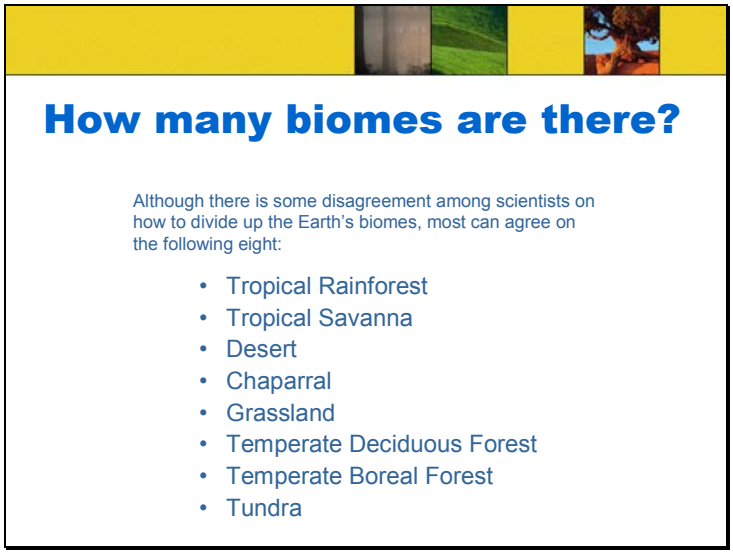
However, climate can also be affected by elevation. Thus, biomes that are typically found closer to the poles may also be found on mountains located near the equator.

Slide 4



For purposes of this class, we will consider there to be eight biomes…

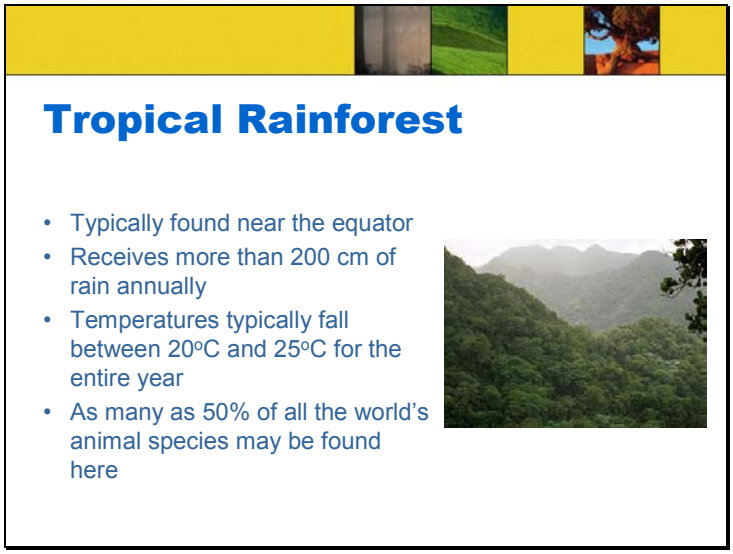
Slide 5



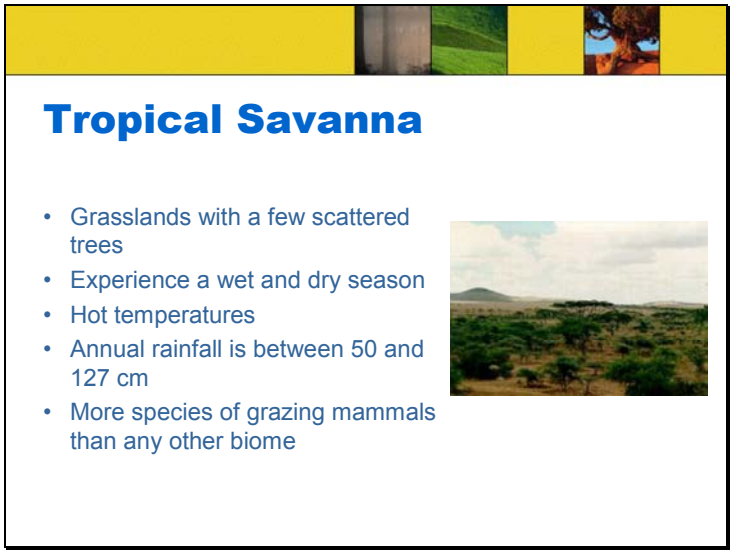
…However, there is some disagreement among scientists about how many biomes there should be. Some argue that there are as few as five and others that there are as many as thirteen or more. For our purposes, we will focus only on the terrestrial (land) biomes. If we included aquatic, there would be even more.

The eight biomes represented here are pretty standard, but they are relatively generic. It is possible to divide these into smaller biomes. For example, we could break the tundra into arctic tundra and alpine tundra.

Slide 6


Tropical Rainforest
• Typically found near the equator
• Receives more than 200 cm of rain annually
• Temperatures typically fall between 20°C and 25°C for the entire year
• As many as 50% of all the world's animal species may be found here

Slide 7


Tropical Savanna
• Grasslands with a few scattered trees
• Experience a wet and dry season
• Hot temperatures
• Annual rainfall is between 50 and 127 cm
• More species of grazing mammals than any other biome

Slide 8

Desert

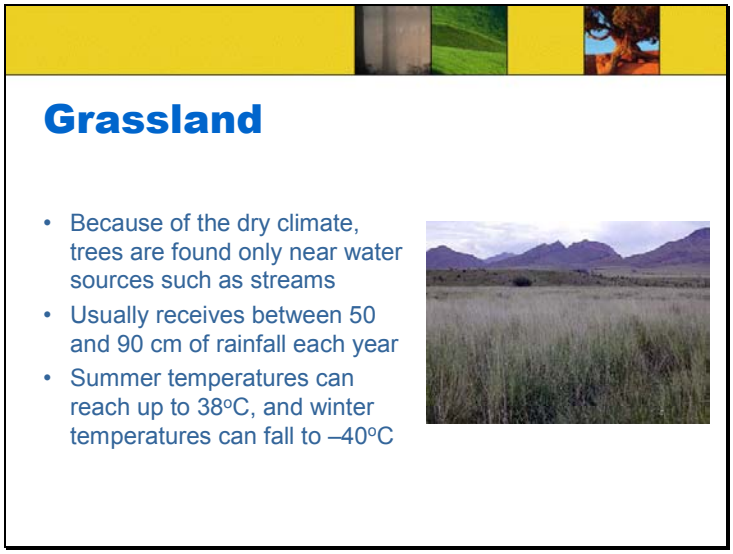
- Typically found between 25° and 40° latitude
- Receives less than 25 cm of rain each year
- Temperatures typically range between 20°C and 25°C but some extreme deserts can reach temperatures higher than 38°C and lower than –15°C

Slide 9

Chaparral

- Found between 32° and 40° latitude on the west coast of continents
- Receives between 35 and 70 cm of rain, usually in the winter
- Extremely resistant to drought and weather events

Slide 10

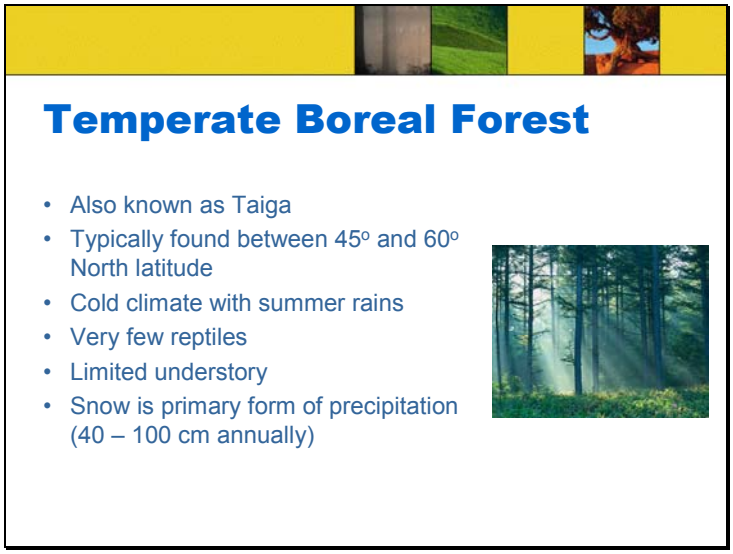

Grassland
• Because of the dry climate, trees are found only near water sources such as streams
• Usually receives between 50 and 90 cm of rainfall each year
• Summer temperatures can reach up to 38°C, and winter temperatures can fall to –40°C

Slide 11

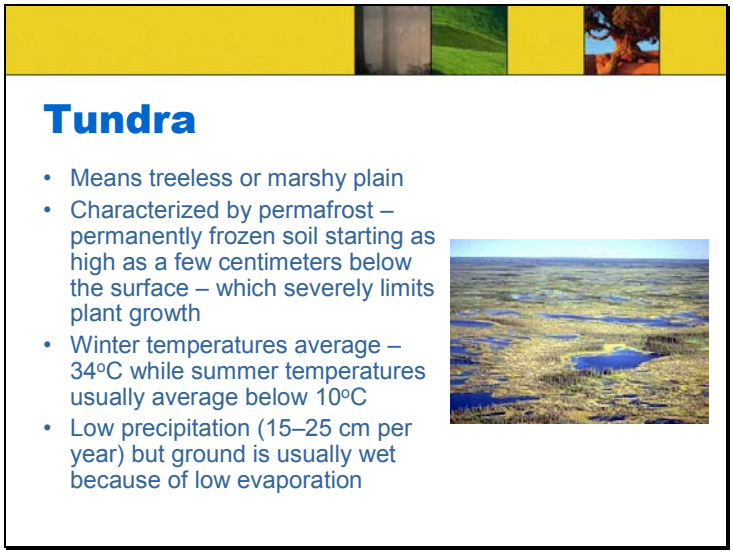
Temperate Deciduous Forest

- Moderate climate
- Most trees will lose their leaves in the winter
- Temperatures range between –30°C and 30°C
- Averages from 75 to 150 cm of precipitation
- Well developed understory

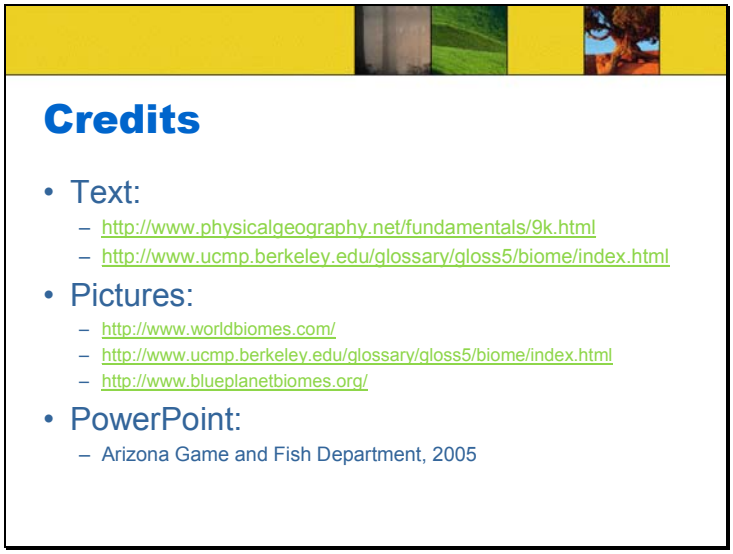
Slide 12


Temperate Boreal Forest
• Also known as Taiga
• Typically found between 45° and 60° North latitude
• Cold climate with summer rains
• Very few reptiles
• Limited understory
• Snow is primary form of precipitation (40 – 100 cm annually)

Slide 13


Tundra
• Means treeless or marshy plain
• Characterized by permafrost – permanently frozen soil starting as high as a few centimeters below the surface – which severely limits plant growth
• Winter temperatures average – 34°C while summer temperatures usually average below 10°C
• Low precipitation (15–25 cm per year) but ground is usually wet because of low evaporation

Slide 14



Credits

- Text:
  - http://www.physicalgeography.net/fundamentals/9k.html
  - http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html
- Pictures:
  - http://www.worldbiomes.com/
  - http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html
  - http://www.blueplanetbiomes.org/
- PowerPoint:
  - Arizona Game and Fish Department, 2005

Biome Research

Your group has been assigned one of the biomes discussed in class. You will now become the teacher. You must use the Internet to research this biome, focusing on the required elements listed below. Once the research is complete, put the information together in an interesting and meaningful way for your classmates. Remember: you want this to be exciting. Don't just lecture. Get the class involved. Try to use at least one visual aid (overhead, computer, poster, etc.).

For your assigned biome, you must have:

1. A general description of the biome, including location, general climate, seasons, and plant and animal adaptations.
2. A world map with the global distribution of the biome clearly marked.
3. A representative climograph showing monthly precipitation and temperatures.
4. A vegetation profile (a typical side view of the biome) that shows the vertical distribution of plants, emphasizing any canopy or understory.
5. A food web containing animals and plants at the following trophic levels: producers, primary consumers, secondary consumers, top predators, and decomposers.
6. Pictures of the biome as well as common animals and plants found there.
7. Three questions that can be used on a test at the end of the presentations.

The following Web sites will provide you with background information:

The World's Biomes
http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html

World Biomes
http://www.worldbiomes.com/

Land Biomes
http://biology.about.com/od/landbiomes/a/aa061297a.htm

Characteristics of Earth's Terrestrial Biomes
http://www.physicalgeography.net/fundamentals/9k.html

Earth Floor: Biomes
http://www.cotf.edu/ete/modules/msese/earthsysflr/biomes.html

World Builders: Introduction to Biomes
http://curriculum.calstatela.edu/courses/builders/lessons/less/biomes/introbiomes.html

The Virtual Zoo: Habitats
http://library.thinkquest.org/11922/habitats/habitats.htm

Introduction to Biomes
http://www.runet.edu/~swoodwar/CLASSES/GEOG235/biomes/intro.html

Exploring Biomes

Oral Presentation Rubric

The following rubric will be used to evaluate your presentation. Use it as a guideline as you prepare.

CATEGORY	4	3	2	1
Organization	Information is presented in a clear, logical, and interesting manner that the audience can easily follow.	Information is presented in a clear sequence that the audience can follow.	Presentation jumps between topics and audience has difficulty following.	There is no sequence and the audience cannot follow.
Knowledge	Explanations show full knowledge, all required elements are included, and questions are answered appropriately.	Explanations are complete, all required elements are included, and questions are answered by lack detail.	Explanations are not detailed, some elements are missing, and answers to questions are incomplete.	No clear understanding of information, many missing elements, and questions are not answered.
Supporting Graphics and Materials	Graphics are highly visible and reinforce presentation.	Graphics are visible and relate to the presentation	Graphics are difficult to see or are not very relevant to the presentation.	There are no graphics or supporting materials.
Eye Contact	Students maintain eye contact with the audience, rarely referring to notes.	Students maintain eye contact for most of the time but refer often to notes.	Students read most of the report and rarely look at audience.	Students never look at audience.
Mechanics	Rate and volume of voice is clear, appropriate language is used, and speaker is poised.	Voice is clear and most of the audience can hear, appropriate language is used, and speaker is somewhat poised.	Difficult to hear or understand speaker some words are not appropriate, speaker moves or rocks quite a bit.	Speaker mumbles, has poor word choice, and is constantly moving or rocking.

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

Exploring Biomes

Lesson 3: Endangered Biomes

LESSON OVERVIEW

In recent years, controversy has developed over how best to preserve the diversity of plants and animals on the Earth. In this lesson, students will have the opportunity to compare data from two proposed strategies and come to their own conclusions.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- The expansion of human populations can negatively affect the diversity of plants and animals.
- Conservation solutions are complex and people may not agree.

OBJECTIVES

Students will:

- Calculate ratios.
- Identify the similarities and differences between world biomes.
- Use data to analyze two solutions to a problem.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C3-02; S1-C3-03; S1-C3-04; S1-C4-03; S1-C4-05; S2-C2-01; S2-C2-02; S3-C2-02	S1-C1-01; S1-C1-04; S1-C2-03; S2-C1-04; S2-C1-06; S2-C1-07	None
7	S1-C3-02; S1-C3-05; S1-C4-03; S1-C4-05; S2-C2-01; S2-C2-02; S3-C1-01; S3-C1-03; S3-C2-02; S4-C3-04	S1-C2-06; S1-C2-07; S2-C1-05; S2-C1-07; S2-C1-08	
8	S1-C3-02; S1-C3-05; S1-C4-03; S1-C4-05; S2-C2-02; S3-C2-02	S1-C2-06; S2-C1-08	
High School	S1-C3-03; S1-C3-06; S1-C4-03; S1-C4-04; S3-C1-01; S3-C1-05; S3-C2-05	S1-C2-03; S2-C1-09; S2-C1-11	None

Note: The full text of these standards can be found in Appendix A.

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

TIME FRAME

- 1 day (45 minutes)

MATERIALS

- *Endangered Biomes* worksheet (one per student)
- Calculators

TEACHER PREPARATION

- Make a copy of the *Endangered Biomes* worksheet for each student.
- Gather enough calculators for students to use.
- Students need to have a basic understanding of the climates that characterize various biomes. If students have not completed Lesson 2 – Biome Research, allow them to research information on the Internet before or during this activity.
- Students should understand how to calculate and interpret ratios.

TEACHER BACKGROUND

Human population growth is taking its toll on the environment. Deforestation, grazing, and pollution are just some of the ways that critical habitats are being destroyed. As a result, thousands of plants and animals are becoming endangered or, even worse, approaching extinction. Scientists are trying to develop strategies to protect these species, but funding is in short supply.

For years, the leading strategy for conservation biologists has been to focus on biodiversity hotspots. These are areas that have extremely high concentrations of unique species but have lost more than 70% of their original vegetation. So far, 34 hotspots have been identified. Combined, these locations account for more than 50% of the world's plant species and 42% of its terrestrial vertebrate species. They cover only 2.3% of the world's total land area. Proponents of this idea believe that by focusing on these areas, a relatively small amount of money and effort can be used to save a large number of species.

For many people this solution is not adequate because the significant majority of biodiversity hotspots are found in tropical rainforests. These people believe that an intense effort to save such a small amount of land will ultimately destroy the Earth's diversity. Instead, they say, we should focus our efforts and resources on preserving a representative sample of all biomes, starting with the ones that are most threatened, such as chaparral and grasslands. This strategy will allow us to preserve larger areas of land, which could also ensure the survival of large carnivores such as wolves and lions.

For additional information about either of these strategies, check out the resources below:

"Biodiversity Hotspots." *Conservation International*. http://www.biodiversityhotpsots.org.

Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. and Roberts, C. (2005) Confronting a biome crisis: Global disparities of habitat loss and protection. *Ecology Letters*, 8, 23-29.

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

SUGGESTED PROCEDURES

1. Ask students to name the biomes with which they are familiar. Which of these is most important? Why? Which of these is in greatest need of being protected? Point out that not everyone in the class agrees to the answers to these questions, and the same is true of scientists. The students will now have the opportunity to explore this idea in more detail.
2. Hand out the *Endangered Biomes* worksheet to each student.
3. As a class, read the first page. Briefly discuss the Biodiversity Hotspot and the Endangered Biome strategies to be sure that students understand the basic differences between them.
4. Students now have the opportunity to compare the two conservation strategies to see how they can result in differing ideas about which lands are important to conserve. Students complete the worksheet independently.
5. Allow students time in or out of class to finish.
6. When all of the students have completed the worksheet, invite them to share their views about which strategy is "better" along with their reasons. Discuss any similar or opposing opinions with the class.
7. Collect the *Endangered Biomes* worksheet.

ASSESSMENT

- Class discussion
- *Endangered Biomes* worksheet

EXTENSIONS

- Students can map the locations of the thirty-four biodiversity hotspots found on http://www.biodiversityhotspots.org, compare the map to biome maps, and try to determine how many are found in each of the biomes.
- Students can use the Internet to research both arguments in more depth and write a persuasive essay.

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
6	1	3 – Analysis and Conclusions	2 – Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events) 3 – Evaluate the observations and data reported by others 4 – Interpret simple tables and graphs produced by others
		4 – Communication	3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information 5 – Communicate the results and conclusion of the investigation
	2	2 – Nature of Scientific Knowledge	1 – Describe how science is an ongoing process that changes in response to new information and discoveries 2 – Describe how scientific knowledge is subject to change as new information and/or technology challenges prevailing theories
	3	2 – Science and Technology in Society	2 – Compare possible solutions to best address an identified need or problem
7	1	3 – Analysis and Conclusions	2 – Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events) 5 – Formulate a conclusion based on data analysis
		4 – Communication	3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information 5 – Communicate the results and conclusion of the investigation
	2	2 – Nature or Scientific Knowledge	1 – Describe how science is an ongoing process that changes in response to new information and discoveries 2 – Describe how scientific knowledge is subject to change as new information and/or technology challenges prevailing theories

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

Science Standards Continued

Grade	Strand	Concept	Performance Objective
7	3	1 – Changes in Environments	1 – Analyze environmental risks (e.g., pollution, destruction of habitat) caused by human interaction with biological or geological systems 3 – Propose possible solutions to address the environmental risks in biological or geological systems
		2 – Science and Technology in Society	2 – Compare possible solutions to best address an identified need or problem
	4	3 – Populations of Organisms in an Ecosystem	4 – Evaluate data related to problems associated with population growth (e.g., overgrazing, forest management, invasion of non-native species) and the possible solutions
8	1	3 – Analysis and Conclusions	2 – Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events) 5 – Explain how evidence supports the validity and reliability of a conclusion
		4 – Communication	3 – Present analyses and conclusions in clear, concise formats 5 – Communicate the results and conclusion of the investigation
	2	2 – Nature or Scientific Knowledge	2 – Describe how scientific knowledge is subject to change as new information and/or technology challenges prevailing theories
	3	2 – Science and Technology in Society	2 – Compare solutions to best address an identified need or problem
High School	1	3 – Analysis and Conclusions	3 – Critique reports of scientific studies (e.g., published papers, student paper) 6 – Use descriptive statistics to analyze data, including: • mean • frequency • range
		4 – Communication	3 – Communicate results clearly and logically 4 – Support conclusions with logical scientific arguments

Science Standards Continued

Grade	Strand	Concept	Performance Objective
High School	3	1 – Changes in Environments	1 – Evaluate how the processes of natural ecosystems affect, and are affected by, humans 5 – Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality and biodiversity
		2 – Science and Technology in Society	5 – Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology)

Mathematics Standards

Grade	Strand	Concept	Performance Objective
6	1	1 – Number Sense	1 – Express fractions as ratios, comparing two whole numbers (e.g., ¾ is equivalent to 3:4 and 3 to 4) 4 – Determine the equivalency between and among fractions, decimals, and percents in contextual situations
		2 – Numerical Operations	3 – Apply grade-level appropriate properties to assist in computation
	2	1 – Data Analysis (Statistics)	4 – Answer questions based on simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs 6 – Identify a trend (variable, increasing, decreasing, remaining constant) from displayed data 7 – Compare trends in data related to the same investigation
7	1	2 – Numerical Operations	6 – Divide integers 7 – Apply grade-level appropriate properties to assist in computation
	2	1 – Data Analysis (Statistics)	5 – Answer questions based on data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs 7 – Interpret trends from displayed data 8 – Compare trends in data related to the same investigation
8	1	2 – Numerical Operations	6 – Apply grade-level appropriate properties to assist in computation
	2	1 – Data Analysis (Statistics)	8 – Compare trends in data related to the same investigation

Mathematics Standards Continued

Grade	Strand	Concept	Performance Objective
High School	1	2 – Numerical Operations	3 – Simplify numerical expressions including signed numbers and absolute values
	2	1 – Data Analysis (Statistics)	9 – Draw inferences from charts, tables, graphs, plots, or data sets 11 – Evaluate the reasonableness of conclusions drawn from data analysis

Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

A. *Endangered Biomes Worksheet* – A worksheet that allows students to compare two differing ideas about habitat conservation (2 pages)

B. *Endangered Biomes Worksheet: Teacher Version* – The answers to the student worksheet (2 pages)

Endangered Biomes

The debate is on! With so many ecosystems threatened by expanding human populations and relatively limited funds to save them, conservation biologists are trying to determine the best way to maintain the world's biodiversity.

For years, the leading strategy has been to focus on saving *biodiversity hotspots*. Basically, these are areas of the world that have lost at least 70% of their original vegetation, but have high concentrations of species found nowhere else in the world. Thirty-four hotspots have been identified. Most of them are found in the tropical rainforests. These locations make up only 2.3% of the Earth's total land area, but account for more than 50% of its plant species and 42% of its terrestrial vertebrate species.[1]

For many scientists, this is not an adequate solution. They believe that such an intense effort to save such a small amount of land, most of which is limited to a single biome, threatens the rest of the Earth's ecosystems that are so valuable to other species (like the large carnivores that need vast areas to roam) as well as to humans.

As a result, these scientists have suggested we focus our resources (i.e., time, money, and energy) on conserving endangered biomes instead of individual hotspots. They believe that this strategy will save a larger representation of the Earth's species and will be of greater benefit to biodiversity in the long run.

To determine how endangered a biome is, scientists compare the percent of habitat that humans have converted within a biome to the percent of habitat that has been protected. These percentages are represented in the table below. Use them to answer the questions that follow.

Table 1: Biome land converted and protected[2]

Biome	Habitat Converted	Habitat Protected	Conversion:Protection Ratio
Tropical Rainforest	32.2	16	
Tropical Savanna	23.6	11.9	
Desert	6.8	9.9	
Chaparral	41.4	5	
Grassland	45.8	4.6	
Temperate Deciduous Forest	46.6	9.8	
Temperate Boreal Forest	2.4	8.9	
Tundra	0.4	16	
Total	**2**	**1**	

[1] "Biodiversity Hotspots." Conservation International. http://www.biodiversityhotspots.org.

[2] Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. and Roberts, C. (2005). Confronting a biome crisis: Global disparities of habitat loss and protection. *Ecology Letters*, 8, 23-29.

1. In the empty column in Table 1, express the percentages as a ratio of habitat converted to habitat protected.

2. According to proponents of the endangered biome conservation strategy, the larger the ratio between habitat converted to habitat protected, the more endangered that biome is. List the biomes in order from most endangered to least endangered, along with their ratios, in the table below.

Table 2: Rankings of endangered biomes according to Conversion:Protection ratio

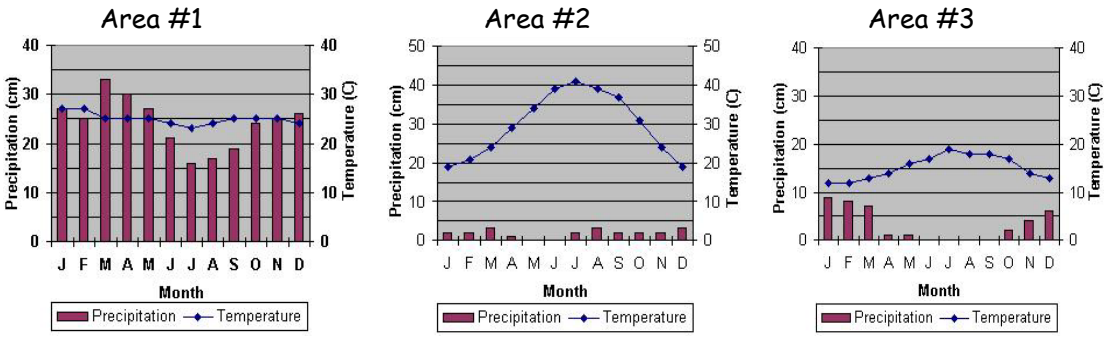
Rank	Biome	C:P Ratio
1		
2		
3		
4		
5		
6		
7		
8		

3. According to the Biodiversity Hotspot idea described in the reading, in which biome should we be focusing our efforts?

4. Why do you believe these two conservation strategies do not agree?

5. Based on the information presented here, which strategy do you think is best? Why?

Below are the climographs for three areas that are being considered for immediate conservation. Use your knowledge of biomes to answer questions #6 – 8.



6. According to the Biodiversity Hotspot idea, which area should be conserved? Explain.

7. According to the Endangered Biomes idea, which area should be conserved? Explain.

8. According to the Endangered Biomes idea, which area is least in need of conservation? Explain.

Endangered Biomes – Teacher Version

The debate is on! With so many ecosystems threatened by human population and relatively limited funds to save them, conservation biologists are trying to determine the best way to maintain the world's biodiversity.

For years, the leading strategy has been to focus on saving *biodiversity hotspots*. Basically, these are areas of the world that have lost at least 70% of their original vegetation but have high concentrations of species found nowhere else in the world. Thirty-four hotspots have been identified, most of which are found in the tropical rainforests. These locations make up only 2.3% of the Earth's total land area, but account for more than 50% of its plant species and 42% of its terrestrial vertebrate species.[1]

For many scientists, this is not an adequate solution. They believe that such an intense effort to save such a small amount of land, most of which is limited to a single biome, threatens the rest of the Earth's ecosystems that are so valuable to other species (like the large carnivores that need vast areas to roam) as well as to humans.

As a result, these scientists have suggested we focus our resources (i.e., time, money, and energy) on conserving endangered biomes instead of individual hotspots. They believe that this will save a larger representation of the Earth's species and will be of greater benefit to biodiversity in the long run.

To determine how endangered a biome is, scientists compare the percent of habitat that humans have converted within a biome to the percent of habitat that has been protected. These percentages are represented in the table below. Use them to answer the questions that follow.

Table 1: Biome land converted and preserved[2]

Biome	Habitat Converted	Habitat Protected	Conversion:Protection Ratio
Tropical Rainforest	32.2	16	*2:1*
Savanna	23.6	11.9	*2:1*
Desert	6.8	9.9	*2:3*
Chaparral	41.4	5	*8:1*
Grassland	45.8	4.6	*10:1*
Temperate Deciduous Forest	46.6	9.8	*5:1*
Boreal Forest	2.4	8.9	*1:4*
Tundra	0.4	16	*1:40*
Total	**2**	**1**	*2:1*

[1] "Biodiversity Hotspots." Conservation International. http://www.biodiversityhotspots.org.

[2] Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. and Roberts, C. (2005). Confronting a biome crisis: Global disparities of habitat loss and protection. *Ecology Letters*, 8, 23-29.

1. In the empty column in Table 1, express the percentages as a ratio of habitat converted to habitat protected.

2. According to proponents of the endangered biome conservation strategy, the larger the ratio between habitat converted to habitat protected, the more endangered that biome is. List the biomes in order from most endangered to least endangered, along with their ratios, in the table below.

Table 2: Rankings of endangered biomes according to Conversion:Protection ratio

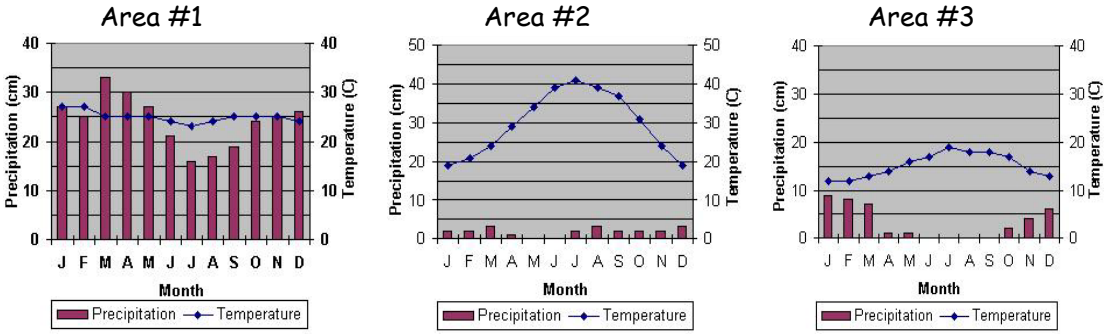
Rank	Biome	C:P Ratio
1	*Grassland*	*10:1*
2	*Chaparral*	*8:1*
3	*Temperate Deciduous Forest*	*5:1*
4	*Tropical Rainforest*	*2:1*
5	*Savanna*	*2:1*
6	*Desert*	*2:3*
7	*Boreal Forest*	*1:4*
8	*Tundra*	*1:40*

3. According to the Biodiversity Hotspot idea described in the reading, in which biome should we be focusing our efforts? *Rainforests*

4. Why do you believe these two conservation strategies do not agree?
   Answers will vary.

5. Based on the information presented here, which strategy do you think is best? Why?
   Answers will vary.

Below are the climographs for three areas that are being considered for immediate conservation. Use your knowledge of biomes to answer questions #6 – 8.



6. According to the Biodiversity Hotspot idea, which area should be conserved? Explain.
   Area 1. Climograph clearly shows a rainforest.

7. According to the Endangered Biomes idea, which area should be conserved? Explain.
   Area 3. Climograph clearly shows a chaparral.

8. According to the Endangered Biomes idea, which area is least in need of conservation? Explain.
   Area 2. Climograph shows a desert, which is the lowest of the three.

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

Exploring Biomes

Lesson 4: Mapping Arizona

LESSON OVERVIEW

Just like the world, Arizona can be divided into biomes. Moreover, because we are working at a smaller scale, Arizona's biomes can be divided into smaller groups called biotic communities. In this lesson, students use a map to measure and compare the biotic communities of Arizona.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- At smaller scales, such as states, biomes can be divided into smaller, more specific groups called biotic communities
- Because of its wide range in elevations, Arizona has numerous biotic communities and is represented by almost all biomes

OBJECTIVES

Students will:

- Define what a biotic community is.
- Identify the biotic communities of Arizona.
- Use a scale map to estimate the area of the biotic communities of Arizona.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C2-04; S1-C3-01; S1-C4-02; S1-C4-03	S1-C2-01; S1-C2-02; S1-C2-14; S1-C3-01; S2-C1-03; S2-C1-04; S4-C4-11	None
7	S1-C2-04; S1-C3-01; S1-C4-02; S1-C4-03	S1-C2-03; S1-C2-04; S1-C2-06; S1-C2-10; S1-C3-01; S1-C3-03; S2-C1-02; S2-C1-04; S2-C1-05	
8	S1-C2-04; S1-C3-01; S1-C4-03	S1-C2-01; S1-C2-02; S1-C3-01; S2-C1-04; S2-C1-05	
High School	S1-C3-06; S1-C4-02; S1-C4-04	S1-C2-01; S1-C2-02; S1-C3-01; S2-C1-02	None

Note: The full text of these standards can be found in Appendix A.

An online exploration of the biotic communities of Arizona with an emphasis on Mathematics and Technology

TIME FRAME

- 1 – 2 days (45 minutes each day)

MATERIALS

- Computers with Internet access
- "Exploring Arizona's Natural Resources" access (Web site or CD available from azgfd.gov)
- Rulers
- *Biotic Communities of Arizona* worksheet (one per student)
- *Biotic Communities of Arizona* map (one per student)

TEACHER PREPARATION

- Review the "Exploring Arizona's Natural Resources" Web site or CD.
- Make a copy of the *Biotic Communities of Arizona* worksheet and map for each student.

SUGGESTED PROCEDURES

1. Ask students to name biomes that they think occur in Arizona. Solicit answers and discuss. Make sure students are aware that every biome except Tropical Rainforest and Savanna is found in Arizona.
2. Introduce the idea of scale. Since Arizona is smaller than the world, we can look at each biome in a little more detail. As a result, some of the biomes can be divided into smaller groups based on differences that are not as relevant at the large scale of the Earth. We will refer to these smaller groupings as biotic communities. Students will now have the opportunity to explore the biotic communities of Arizona.
3. Open the "Exploring Arizona's Natural Resources" Web site or CD with students, and provide an overview. Show them that each biotic community they click on will provide some information about the community as well as some representative plants and animals found there.
4. Distribute rulers, the *Biotic Communities of Arizona* worksheet, and the *Biotic Communities of Arizona* map to the students. Inform them that they are to use the Web site/CD to answer the questions about each biotic community. Then, they must use the map and the ruler to calculate the approximate area of each of Arizona's biotic communities. Emphasize that even though they will be estimating the area of each biotic community, they need to be as accurate as possible.
5. Allow the students time in class or at home to complete the worksheet.
6. Compare the students' results. Discuss why they may have arrived at different answers. This is a good time to discuss estimation and accuracy.
7. Collect the *Biotic Communities of Arizona* worksheet.

ASSESSMENT

- Class discussion
- *Biotic Communities of Arizona* worksheet

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EXTENSIONS

- Students can compare the percentage of Arizona that is covered by each biotic community (or biome) to the percentage of the world that is covered by each biome.

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
6	1	2 – Scientific Testing (Investigating and Modeling)	4 – Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers)
		3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
		4 – Communication	2 – Display data collected from a controlled investigation 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
7	1	2 – Scientific Testing (Investigating and Modeling)	4 – Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers)
		3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
		4 – Communication	2 – Display data collected from a controlled investigation 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
8	1	2 – Scientific Testing (Investigating and Modeling)	4 – Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers)
		3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
		4 – Communication	3 – Present analyses and conclusions in clear, concise formats
High School	1	3 – Analysis and Conclusions	6 – Use descriptive statistics to analyze data, including: • mean • frequency • range
		4 – Communication	2 – Produce graphs that communicate data 4 – Support conclusions with logical scientific arguments

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Mathematics Standards

Grade	Strand	Concept	Performance Objective
6	1	2 – Numerical Operations	1 – Select the grade-level appropriate operation to solve word problems 2 – Solve word problems using grade-level appropriate operations and numbers 14 – Solve problems involving fractions or decimals (including money) in contextual situations
		3 – Estimation	1 – Solve grade-level appropriate problems using estimation
	2	1 – Data Analysis (Statistics)	3 – Interpret simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs 4 – Answer questions based on simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs
	4	4 – Measurement – Units of Measure – Geometric Objects	11 – Determine the actual measure of objects using a scale drawing or map
7	1	2 – Numerical Operations	3 – Select the grade-level appropriate operation to solve word problems 4 – Solve word problems using grade-level appropriate operations and numbers 6 – Divide integers 10 – Calculate the percent of a given number
		3 – Estimation	1 – Solve grade-level appropriate problems using estimation 3 – Determine whether an estimation of area is approximately equal to the actual measure
	2	1 – Data Analysis (Statistics)	2 – Construct a circle graph with appropriate labels and title from organized data 4 – Interpret data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs 5 – Answer questions based on data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs

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Mathematics Standards Continued

Grade	Strand	Concept	Performance Objective
8	1	2 – Numerical Operations	1 – Select the grade-level appropriate operation to solve word problems 2 – Solve word problems using grade-level appropriate operations and numbers
		3 – Estimation	1 – Solve grade-level appropriate problems using estimation
	2	1 – Data Analysis (Statistics)	4 – Interpret box-and-whisker plots, circle graphs, and scatter plots 5 – Answer questions based on box-and-whisker plots, circle graphs, and scatter plots
High School	1	2 – Numerical Operations	1 – Select the grade-level appropriate operation to solve word problems 2 – Solve word problems using grade-level appropriate operations and numbers 6 – Divide integers 10 – Calculate the percent of a given number
		3 – Estimation	1 – Solve grade-level appropriate problems using estimation
	2	1 – Data Analysis (Statistics)	2 – Organize collected data into an appropriate graphical representation

Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

A. *Biotic Communities of Arizona Worksheet* – A worksheet students use to estimate the area of each biotic community in Arizona and present their estimates on a circle graph (2 pages)

B. *Biotic Communities of Arizona Map* – A map showing the size and locations of the various communities in Arizona (1 page)

Biotic Communities of Arizona

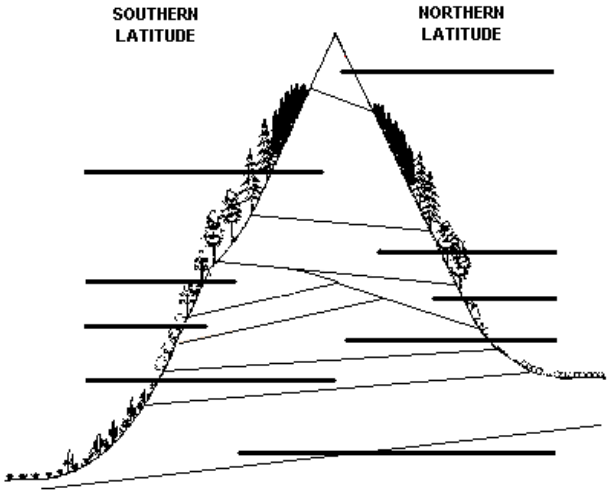
Use the "Exploring Arizona's Natural Resources" Web site or CD to complete the table.

Table 1: Biotic Communities of Arizona

Biotic Community	Elevation Min	Elevation Max	Precipitation	Approximate Area (cm^2)	Percent of Arizona
Alpine Tundra					
Fir Forest					
Pine Forest					
Pinyon-Juniper					
Oak-Pine					
Oak-Woodland					
Mountain Grassland					
Plains Grassland					
Desert Grassland					
Great Basin Desert					
Mohave Desert					
Sonoran Desert					
Chihuahuan Desert					
			Total		*100*

In the space below, make a circle graph showing the percentage that each biotic community occupies in Arizona.

Label the illustration below with the correct biotic communities.



1. In which biotic community do you live?

2. Using your knowledge of world biomes, place the biotic communities of Arizona into their appropriate biomes.

Rainforest	Savanna	Desert	Chaparral	Grassland	Deciduous Forest	Boreal Forest	Tundra

3. In your own words, explain why dividing Arizona into smaller communities is easier than dividing the world into smaller communities.

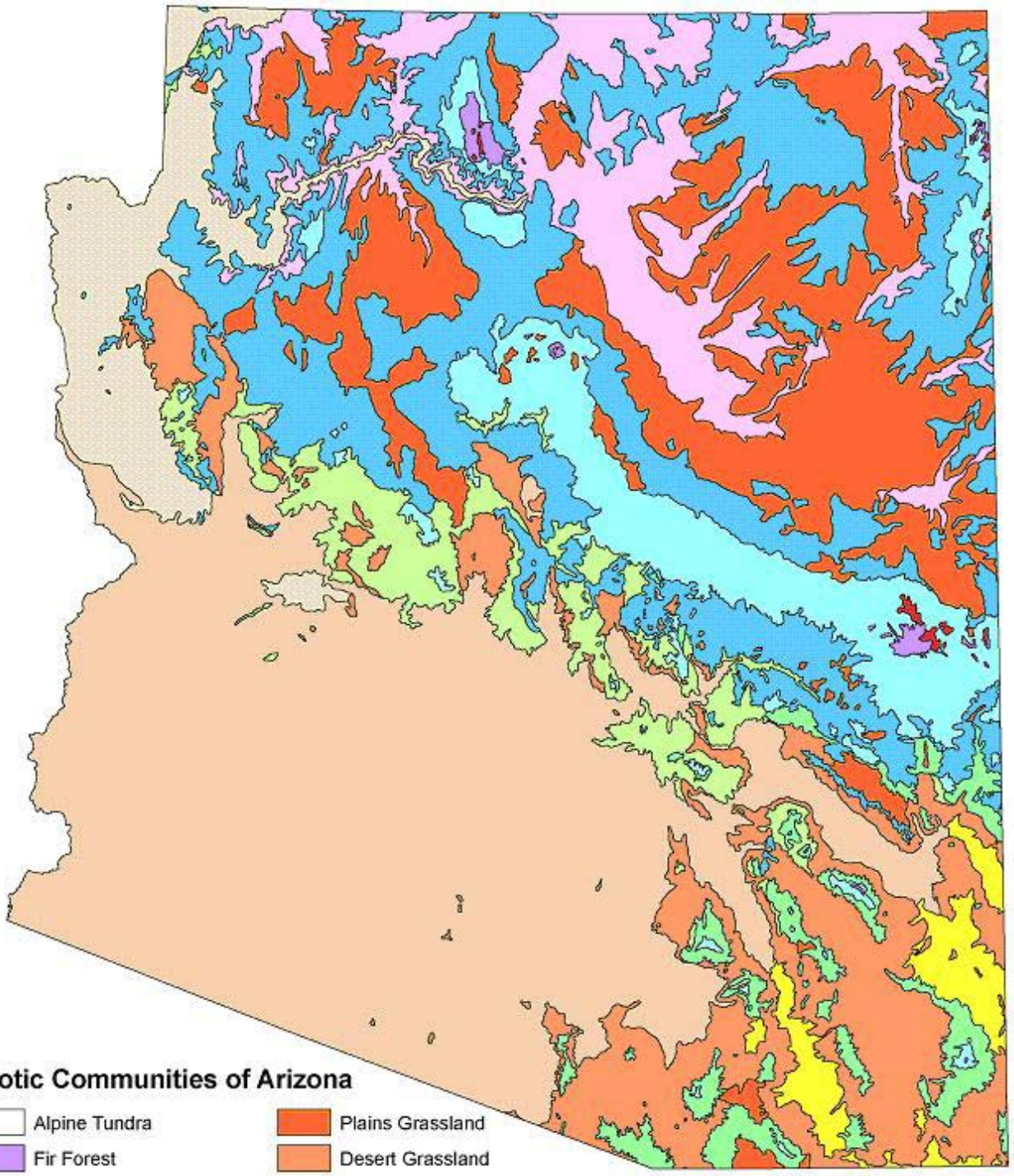
4. What percentage of Arizona is covered by desert?

5. What percentage of Arizona gets at least 12 inches of rain, on average, each year?

6. According to the Biodiversity Hotspot idea mentioned in the previous lesson, how much of Arizona is at the most immediate risk of being lost? Explain.

7. According to the Endangered Biomes idea mentioned in the previous lesson, how much of Arizona is at the most immediate risk of being lost? Explain. *(Note: Let's define a biotic community at immediate risk as one in which five times more land has been converted than has been protected.)*

8. If you could visit any biotic community in Arizona, which would it be and why? Give at least three reasons to support your answer.



Adapted from "Biotic Communities of the Southwest," August 1980, by David E. Brown and Charles H. Lowe

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Exploring Biomes

Lesson 5: You Need a Vacation

LESSON OVERVIEW

In this lesson, students will be assigned to one of the biotic communities of Arizona, and they will use online resources to obtain information about this community. When their research is complete, they will produce a commercial to persuade tourists to visit this biotic community.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- Because of its wide range of elevations, Arizona has numerous biotic communities and is represented by almost all biomes
- Each biotic community in Arizona has distinctive plants, animals, and climate

OBJECTIVES

Students will:

- Use online resources to research a biotic community
- Use PowerPoint to create an automated presentation
- Identify the unique characteristics of Arizona's biotic communities

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C4-03	None	1T-E2-02; 1T-E2-03; 2T-E2-01; 2T-E2-03; 3T-E3-01; 3T-E3-02; 4T-E2-01; 5T-E1-01; 5T-E1-02; 5T-E1-05; 5T-E2-01; 5T-E2-02
7	S1-C4-03	None	
8	S1-C4-01; S4-C4-01	None	
High School	S1-C4-03; S4-C3-01; S4-C3-02	None	3T-P3-01; 4T-P2-01; 5T-P1-03; 5T-P2-01; 5T-P3-02

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- 5 – 7 days (45 minutes each day)

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MATERIALS

- Computers with Internet access
- "Exploring Arizona's Natural Resources" access (Web site or CD available at azgfd.gov)
- Multimedia projector
- Microsoft PowerPoint
- *Biotic Communities Commercial Requirements* (one per student)

TEACHER PREPARATION

- Make enough copies of the *Biotic Communities Commercial Requirements* sheet for each student.
- Schedule computer lab time, if necessary.
- Divide the class into teams of 3 – 4 students.
- Assign each team one of the biotic communities. You may choose to combine the various grassland or desert communities. Or, you could put all of the communities in a "hat" and allow each team to draw one.
- If it is not possible or preferred to use computers to make commercials, the students can make brochures or posters to advertise their biotic community instead.
- Students should have experience with PowerPoint (particularly animations and timings). If possible, you may wish to coordinate with the technology teacher on this project.

SUGGESTED PROCEDURES

1. Introduce the activity by briefly reviewing biotic communities. In which biotic community is our school found? How do you know? If you could visit any biotic community in Arizona, which one would it be? Why? Encourage students to mention a few different communities.
2. Inform the students that they have been "hired" by the Arizona Office of Tourism to produce a short commercial about one of the biotic communities.
3. Distribute the *Biotic Communities Commercial Requirements* sheet. Review the requirements with the class. Emphasize that they will be assigned to a production team and a biotic community. Each team will use PowerPoint to produce a fully automated commercial that lasts between 30 and 45 seconds. They should use the Internet to find information and pictures to include in their commercial. If possible, they should also try to add sound or music.
4. Divide the class into teams and assign (or draw) the biotic communities.
5. Give the teams three to five days to research and develop their commercials. Use your best judgment to determine the time needed.
6. When all teams have completed their commercials, they will share them with the class. Allow them to use the multimedia projector.

ASSESSMENT

- Biotic community commercial

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EXTENSIONS

- Allow the students to show their commercials to a wider audience. Consider open houses, school board meetings, or school announcements.
- Many plants and animals in Arizona are found in more than one biotic community. Students can use the Heritage Data Management System available at azgfd.gov or other online resources to find a species that crosses over into more than one community and identify the adaptations that allow it to survive in the various environments.

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
6	1	4 – Communication	3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
7	1	4 – Communication	3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
8	1	4 – Communication	3 – Communicate the results of an investigation
	4	4 – Diversity, Adaptation and Behavior	1 – Explain how an organism's behavior allows it to survive in an environment
High School	1	4 – Communication	3 – Communicate results clearly and logically
	4	3 – Interdependence of Organisms	1 – Identify the relationships among organisms within populations, communities, ecosystems, and biomes 2 – Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment

Technology Standards

Grade	Strand	Concept	Performance Objective
6, 7, 8	1	2 – Demonstrate increasingly sophisticated operation of technology components	2 – Retrieve and save information remotely (e.g., network servers, Internet, Intranet, peripheral devices) 3 – Demonstrate functional operation of technology devices (e.g., presentation devices, digital cameras, scanners, document cameras, scientific probes)
	2	2 – Exhibit legal and ethical behaviors when using technology and information and discuss consequences of misuse	1 – Follow the rules for deciding when permission is needed for using the work of others, (e.g., some sites specify whether permission is required or not, some work is in public domain) 3 – Provide complete citations from electronic media (e.g., use age-level appropriate, district developed standardized reference formats for citing source of information)

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Technology Standards

Grade	Strand	Concept	Performance Objective
6, 7, 8	3	3 – Publish and present information using technology tools	1 – Design and create a multimedia presentation or Web page using multiple digital sources (e.g., from camera, video, scanner, CD-ROM, Internet) 2 – Publish or present the above production
	4	2 – Use technology tools for individual and collaborative writing, communication and publishing activities to create curricular related products for audiences inside and outside the classroom	1 – Plan, design and present an academic product using technology tools (e.g., multimedia authoring, presentation software, digital cameras, scanners, projection devices)
	5	1 – Locate information from electronic resources	1 – Identify electronic research resources 2 – Define subject searching and devise a search strategy to locate information using available electronic research resources (i.e., electronic card catalog, online or CD-ROM reference sources, grade level appropriate Internet resources) 5 – Identify author, copyright date and publisher of information located in electronic resources, including Internet resources
		2 – Evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources	1 – Create citations for electronic research sources following a prescribed format 2 – Gather research from a variety of electronic sources and identify the most appropriate information for answering the research question
High School	3	3 – Use technology tools to publish and present information with interactive features	1 – Design and create a multimedia presentation of Web site with interactive features (e.g., animation, sound, action buttons to play, video, control devices, open other applications, link to a Web site)

Technology Standards Continued

Grade	Strand	Concept	Performance Objective
High School	4	2 – Manage and communicate personal and professional information utilizing technology tools and resources	1 – Plan and present a product appropriate to the task
	5	1 – Develop a research strategy to find accurate, relevant, appropriate electronic information sources	3 – Independently select appropriate electronic resources from school, community and the world (via online) to be used to locate information when presented with a problem to solve
		2 – Investigate and apply expert systems (e.g., search engines and intelligent agents)	1 – Given a concept, use online search engines as well as resource-specific search features (e.g., CD-ROMs) to find relevant information
		3 – Present research findings from electronic resources using academic models for citations and format	2 – Create citations for resources used following an academic model to present research findings

Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

A. *Biotic Communities Commercial Requirements* – A complete list of the requirements for the commercial including a rubric (2 pages)

Biotic Communities Commercial Requirements

The Arizona Office of Tourism is always looking for unique ways to increase the number of visitors to our state, and they need your help. They are extremely pleased with all of your work on biomes and biotic communities, and they believe that this angle is an untapped resource. Your production team has been asked to develop a short commercial advertising one of the biotic communities of Arizona, with the ultimate goal of motivating more people to visit that particular region. However, the Office of Tourism is very specific about what they are looking for. Be sure to follow the requirements listed below.

Your commercial must:

- Be developed using Microsoft PowerPoint
- Be fully automated (you should not have to advance the slides with the mouse, keyboard, or any other device)
- Last between 30 and 45 seconds
- Focus on your assigned biotic community
- Describe the climate and location of the biotic community
- Feature at least three animals and three plants that can be found in that community along with interesting facts and adaptations about each one
- Contain plenty of pictures, graphics, video, or sound relevant to the topic
- Give at least three reasons why someone should visit
- Include a catchy and memorable slogan to promote tourism to the community

In addition, you must submit a list of all the sources used to develop the commercial. These should be cited in proper format. There should be at least three references used.

Please refer to the rubric on the back to see how each of the commercials will be evaluated.

Commercial Rubric

Use the following rubric to assist as you create your commercial.

CATEGORY	4	3	2	1
Required Content	All required elements (climate, location, 3 animals, 3 plants, 3 reasons, and slogan) are present.	One of the required elements is missing.	Two to three of the required elements are missing.	More than three of the required elements are missing.
Accuracy of Content	All facts included in the commercial are accurate and can be verified with the sources provided.	All facts appear to be accurate but some cannot necessarily be verified with the sources provided.	Most of the facts can be verified but one or two may be incorrect.	More than two of the facts are incorrect.
Mechanics	There are no spelling or grammatical errors in the commercial.	There is only one spelling or grammar mistake.	There are a few (two to four) spelling or grammar mistakes.	There are more than four spelling or grammar mistakes.
Timing	Commercial falls within the required time frame of 30 to 45 seconds.	Commercial falls outside the required time frame by no more two seconds.	Commercial falls outside the required time frame by three to five seconds.	Commercial falls outside the required time frame by more than five seconds.
Audiovisual	All photos, video, and sound make a valuable contribution to the message of the commercial.	Most of the photos, video, and sound are relevant but there are a few that distract from the overall message.	Commercial is text-heavy because there are not enough photos, video, or sound.	There are no photos, video, or sound, or these elements are irrelevant and poorly chosen.
Attractiveness and Organization	The commercial is unique, creative, visually appealing, and well organized.	The commercial is visually appealing and well organized.	The commercial is well organized but does not gain the interest of the audience.	The commercial is hard to follow and lacks organization.
Citations	There are at least three sources used and they are correctly cited.	There are at least three sources but they are not correctly cited.	There are only one or two sources cited.	There are no sources cited.